

We claim:

1. A method of making optical quality films, comprising the steps of:
depositing a first silica film on a wafer by PECVD (Plasma Enhanced
Chemical Vapor Deposition);
5 subjecting the wafer to a first heat treatment to reduce optical absorption,
wafer warp, and compressive stress;
 depositing a second silica film on the wafer by PECVD; and
 subsequently subjecting the wafer to a second heat treatment to reduce
optical absorption, wafer warp and tensile stress.
- 10 2. A method as claimed in claim 1, wherein the first heat treatment follows a
predetermined temperature profile.
3. A method as claimed in claim 2, wherein said first heat treatment
comprises a first phase in which said wafer is stabilized at a first predetermined
temperature, a second phase in which the temperature is ramped up to a second
15 predetermined temperature, a third phase in which the temperature is
maintained at said second predetermined temperature, a fourth phase in which
the temperature is ramped down to a final temperature, and a fifth phase in
which the wafer is stabilized at said final temperature.
4. A method as claimed in claim 3, wherein the duration of said first phase
20 lies in the range 1.3 to 130 minutes.
5. A method as claimed in claim 3, wherein the duration of said first phase is
about 13 minutes.
6. A method as claimed in claim 3, wherein the temperature in said second
phase is ramped up at a rate lying in the range 1°C/min to 25°C/min...
- 25 7. A method as claimed in claim 3, wherein the temperature in said second
phase is ramped up at 5°C/min.
8. A method as claimed in claim 3, wherein said first predetermined
temperature lies in the range 300°C to 700°C.

9.
8. A method as claimed in claim 7, wherein said first predetermined temperature is about 400°C.
10.
9. A method as claimed in claim 8, wherein the temperature in said fourth phase is ramped down at a rate in the range 1°C/min. to 25°C/min.
11.
10. A method as claimed in claim 9, wherein the temperature in said fourth phase is ramped down at 2.5°C/min.
12.
11. A method as claimed in claim 3, wherein said second predetermined temperature lies in the range 800°C to 1,300°C.
13.
12. A method as claimed in claim 11, wherein said second predetermined temperature is about 900°C.
14.
13. A method as claimed in claim 1, wherein said first and second heat treatments are carried out in the presence of an inert gas.
15.
14. A method as claimed in claim 1, wherein said inert gas is selected from the group consisting of: nitrogen, N₂, oxygen, O₂, hydrogen, H₂, water vapour, H₂O, argon, Ar, fluorine, F₂, carbon tetrafluoride, CF₄, nitrogen trifluoride, NF₃, and hydrogen peroxide, H₂O₂.
16.
15. A method as claimed in claim 13, wherein the flow rate of said inert gas is constant.
17.
16. A method as claimed in claim 15, wherein the flow rate of said inert gas lies in the range 1 liter/min. to 100 liters/min.
18.
17. A method as claimed in claim 3, wherein the second heat treatment follows a predetermined temperature profile.
19.
18. A method as claimed in claim 17, wherein said second profile follows the same form as said first profile.
20.
19. A method as claimed in claim 10, wherein deposition is carried out in a seven-dimensional space wherein the flow rates of raw material gas, oxidation gas, carrier gas and dopant gas are set at fixed values, the total deposition

pressure is set at a fixed value, a post-deposition thermal treatment is carried out at a temperature selected from a group of predetermined temperatures, and the observed FTIR characteristics of the resulting product are used to determine the post deposition thermal treatment temperature.

- 5 ~~20.~~^{21.} A method as claimed in claim 19, wherein a first independent variable, the SiH_4 flow, is fixed at about 0.20 std litre/min; a second independent variable, the N_2O flow, is fixed at about 6.00 std litre/min; a third independent variable, the N_2 flow, is fixed at about 3.15 std litre/min; a fourth independent variable, the PH_3 flow, is fixed at about 0.50 std litre/min; a fifth independent variable, the
- 10 total deposition pressure, is fixed at about 2.60 Torr; a sixth independent variable, the post-deposition thermal treatment is varied among the following choices: 30 minutes duration thermal treatment in a nitrogen ambient at 600°C; 30 minutes duration thermal treatment in a nitrogen ambient at 700°C; 30 minutes duration thermal treatment in a nitrogen ambient at 750°C; 30 minutes duration thermal
- 15 treatment in a nitrogen ambient at 800°C; 30 minutes duration thermal treatment in a nitrogen ambient at 850°C; 30 minutes duration thermal treatment in a nitrogen ambient at 900°C.

- ~~21.~~^{22.} A method as claimed in claim 1, wherein the first layer is a silica buffer layer and the second layer is a silica core layer.
- 20 ~~22.~~^{23.} A method as claimed in claim 21, wherein a second buffer layer, symmetrical with said first-mentioned buffer layer, is deposited on the back side of the wafer.

- ~~23.~~^{24.} A method as claimed in claim 22, wherein a protective layer is deposited on the back face of the buffer layer on the back side of the wafer and a
- 25 compensating layer is deposited on the front face of the wafer.

- ~~24.~~^{25.} A method as claimed in claim 24, wherein the protective layer and compensating layer are silicon nitride.

- ~~25.~~^{26.} A method of making a photonic device by PECVD (Plasma Enhanced Chemical Vapor Deposition) comprising:

a) depositing a thick first silica buffer layer on the back side of a wafer;
b) depositing a thick silica buffer layer on the front side of said wafer;
c) subjecting the wafer to a first heat treatment to reduce optical absorption, wafer warp, and compressive stress;

- 5 d) depositing a silica core layer;
e) subsequently to step *d* subjecting the wafer to a second heat treatment to reduce optical absorption, wafer warp and tensile stress; and
f) depositing a silica cladding layer on said silica core layer.

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~~26.~~ A method as claimed in claim 25, wherein said first and second heat
10 treatments follow a predetermined profile and comprises a first phase in which said wafer is stabilized at a first predetermined temperature, a second phase in which the temperature is ramped up to a second predetermined temperature, a third phase in which the temperature is maintained at said second predetermined temperature, a fourth phase in which the temperature is ramped down to a final
15 temperature, and a fifth phase in which the wafer is stabilized at said final temperature.

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~~27.~~ A method as claimed in claim 26, wherein a sacrificial layer is deposited on the front side of the wafer prior to step *a*, an etch protective layer is deposited on said buffer layer on the back side of said wafer, said sacrificial layer is
20 removed after depositing said etch protective layer, and a compensating layer is deposited on the front face of the wafer prior to step *b*.

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~~28.~~ A method as claimed in claim 27, wherein said sacrificial layer is silica.

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~~29.~~ A method as claimed in claim 28, wherein said protective layer and said compensating layer are silicon nitride.

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~~30.~~ A method as claimed in claim 25, wherein said photonic device is a deep-
25 etched optical component.